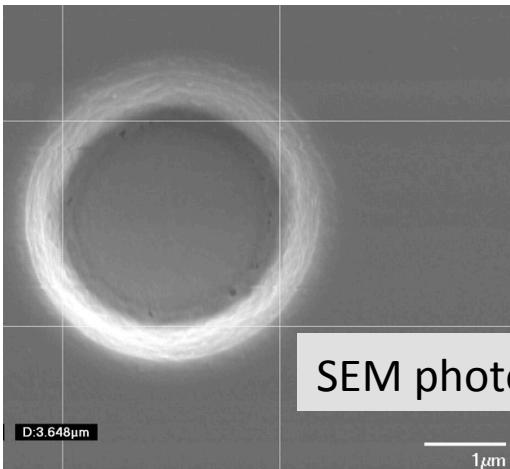


More on pinholes

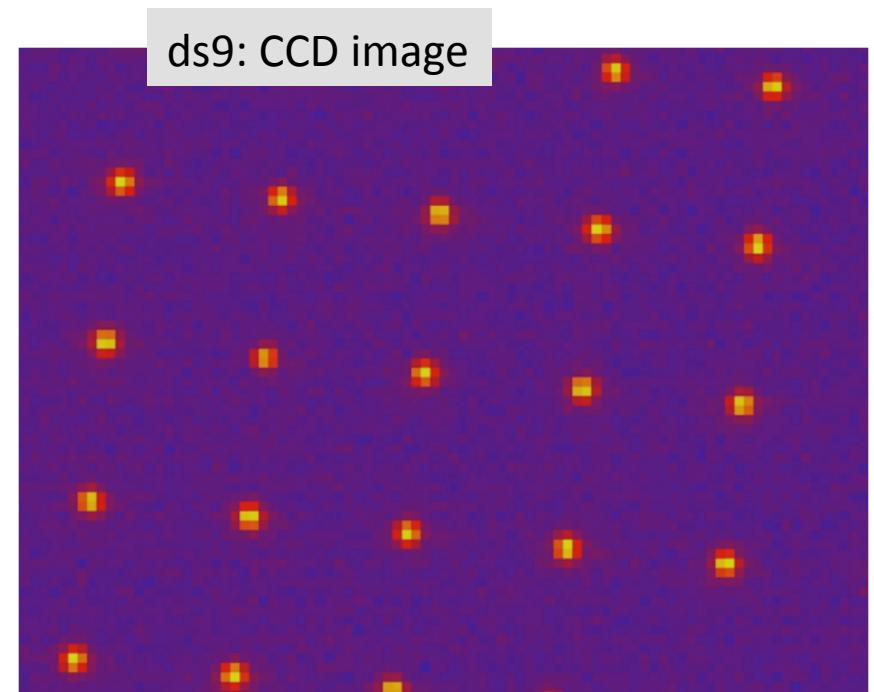
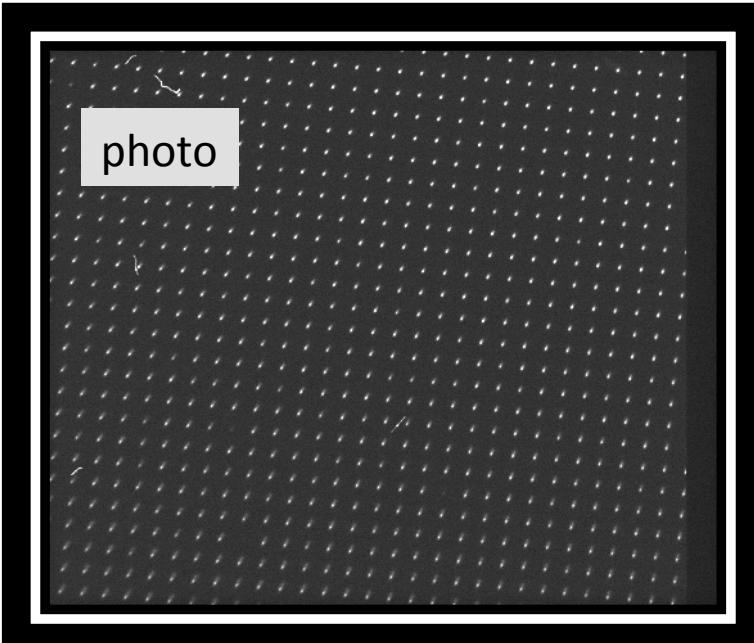
Andrei Nomerotski, 13 April 2015,

Spots: grid of pinholes

- Used multi-hole target to probe astrometric biases
 - 150 nm thick chromium on silica, produced at BNL by J.Warren
 - 46,656 pinholes
 - 3.6 micron diameter, 200 micron spacing



SEM photo of one pinhole



DM based analysis (1)

1. Read and assemble image from FITS (not quite DM..)

```
#           image = AssembleImage(input_file, metadata_file, subtract_background = True)

image = GetImage_SingleAmp(input_file, subtract_background = True, amp_number = 7)
maskedImage = afwImg.MaskedImageF(image)
```

2. Find footprints

```
# find hits| - set up some clustering parameters
    thresholdValue = stdevclip * 10.0
    npixMin = 2
    grow = 4
    isotropic = True

# do the footprint finding
    threshold      = afwDetect.Threshold(thresholdValue, afwDetect.Threshold.VALUE)
    footPrintSet = afwDetect.FootprintSet(maskedImage, threshold, "DETECTED", npixMin)
    footPrintSet = afwDetect.FootprintSet(footPrintSet, grow, isotropic)

    footPrints = footPrintSet.getFootprints()
    footPrintSet.setMask(maskedImage.getMask(), "DETECTED")
    print footPrints.size(), "footPrint(s) found\n"

# loop over found footprints
    footprint = afwDetect.Footprint()
    for footprint in footPrints:
        Ntotal = Ntotal + 1
```

DM based analysis (2)

3. Calculate shapes

```
# calculate shapes using vanilla DM
    centroid_x, centroid_y = footprint.getCentroid()
    npix                      = footprint.getNpix()
    quadshape                  = footprint.getShape()

    axesshape = Ellipses.Axes(quadshape)
    A        = axesshape.getA()
    B        = axesshape.getB()
    theta     = axesshape.getTheta()
```

4. Use ngmix (E.Sheldon) to fit 2D gauss with 6 parameters (flux, x0, y0, sigma, g1, g2)

```
else:
    mc  = MCMCSimple(obs, model, nwalkers=nwalkers, nsub=nsub)

    pos = mc.run_mcmc(guess, burnin)
    pos = mc.run_mcmc(pos,   nstep)
    mc.calc_result()
    result = mc.get_result()
```

DM based analysis (3)

5. Populate histograms/catalog
6. Unwarp the edge (not using now), repeat 4. & 5.

DM ends here...

7. Calculate astrometric shifts and change in shapes
8. Use TreeCorr (M.Jarvis) (not yet) to calculate 2-point correlation function

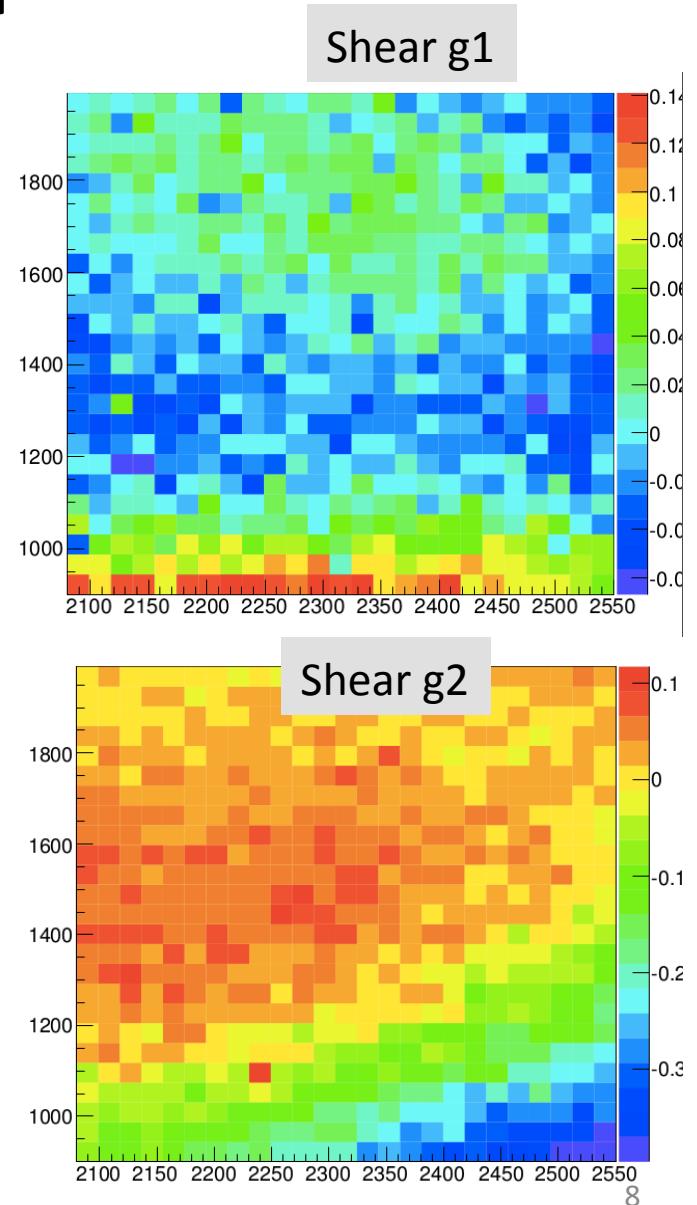
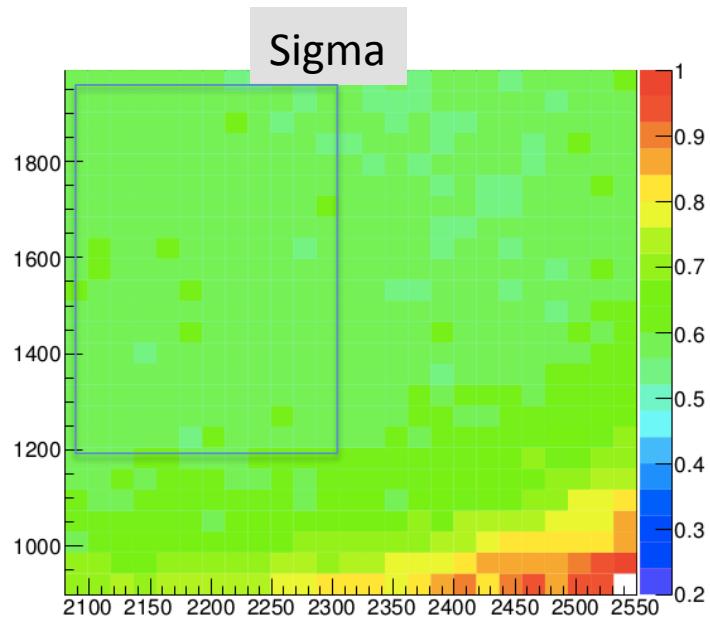
Status

- Available as Ubuntu 12.04 VM now
- Waiting for new DM release to distribute more widely (Ubuntu 14.04 VM)
- VM will have:
 - new DM
 - emcee, fftw, ngmix
 - astropy
 - ROOT, pyroot

Results

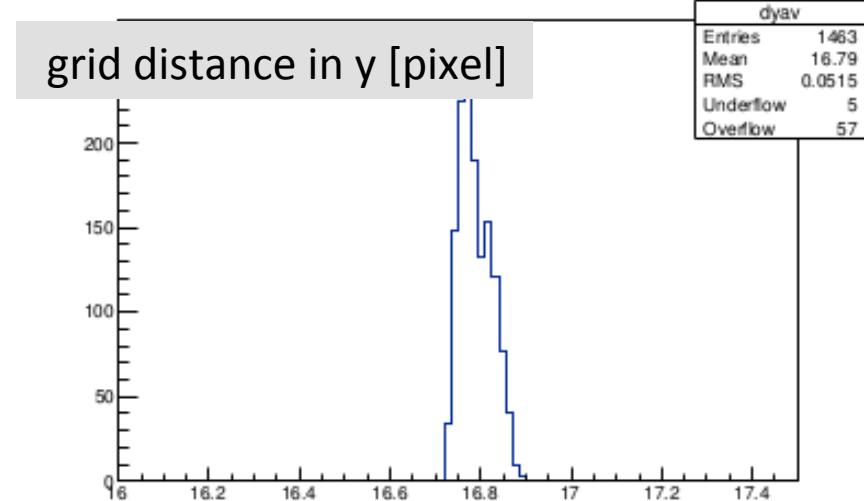
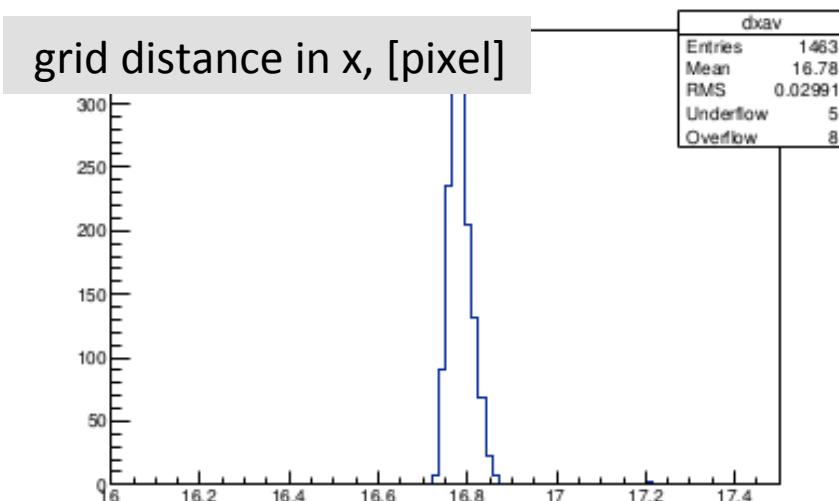
Maps of shapes

- BNL data (O'Connor, Kotov), ITL sensor
- Sigma of spots: 6-7 um
- Some peripheral distortions due to optics
- Selected uniformly illuminated region for further analysis

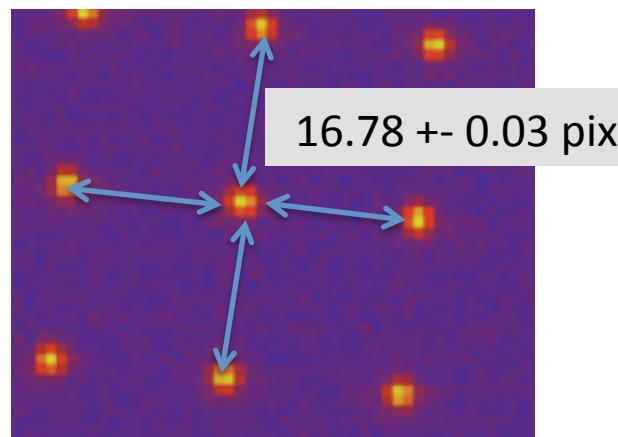


Distance to neighbors

- Along two grid directions “x” and “y”:
 - Average distance to two immediate neighbors

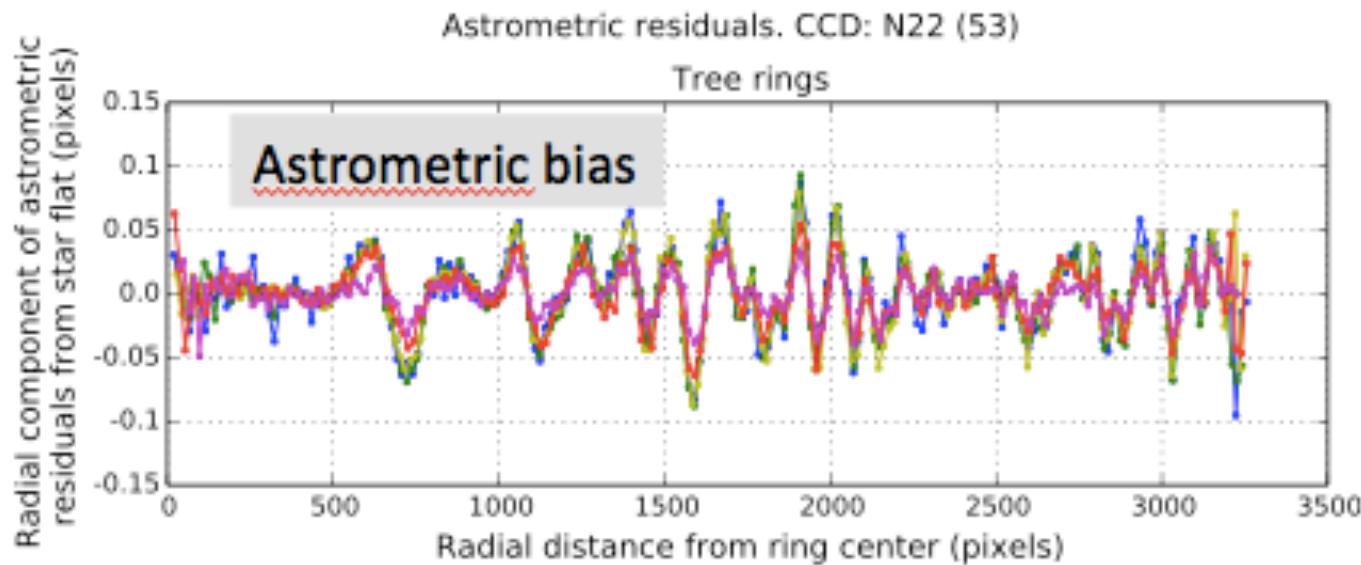


RMS 0.03 pixels = 0.3 micron



DES astrometric bias due to TR

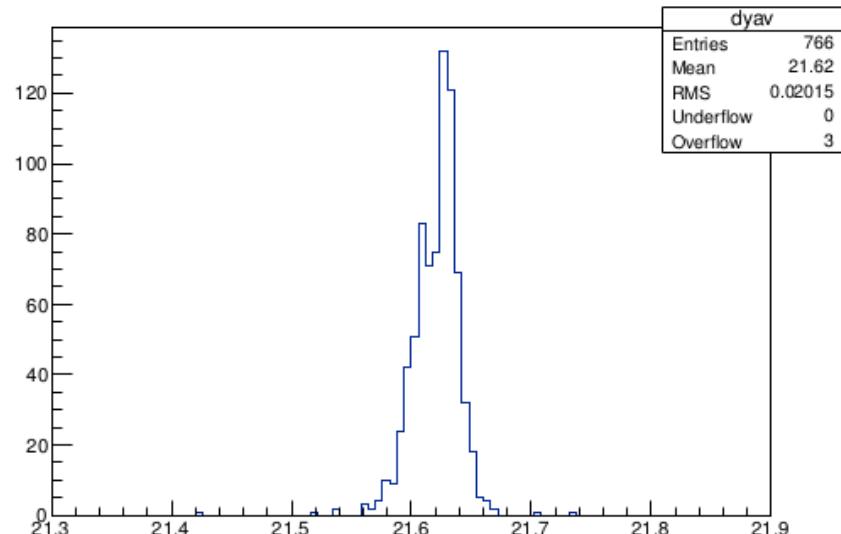
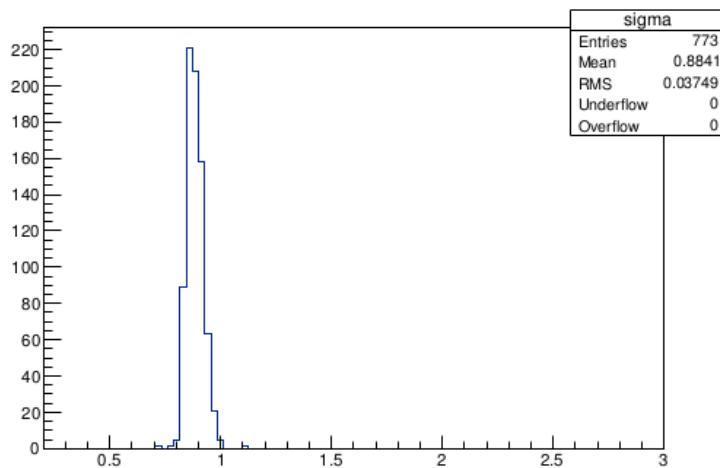
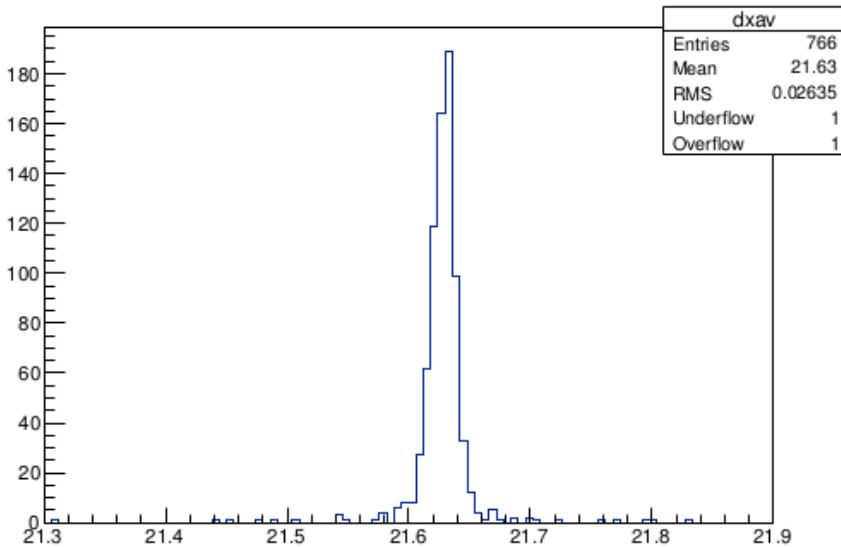
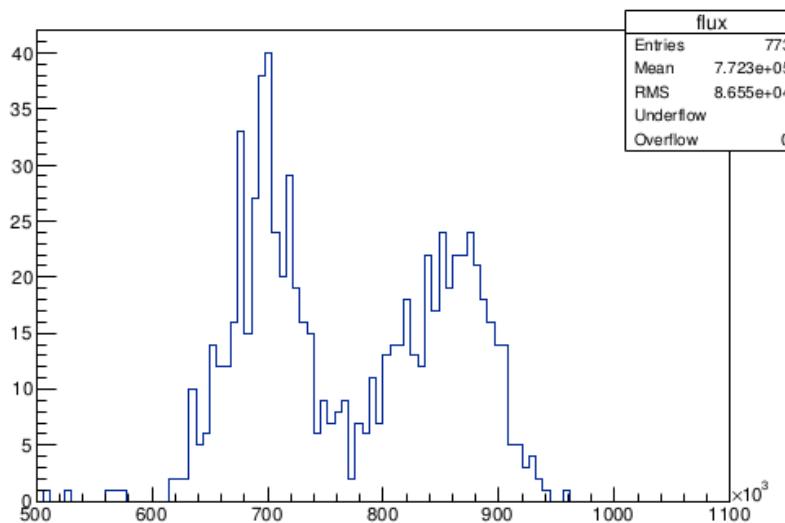
- To be compared to $\sim < 0.75$ micron shifts due to TR in DES



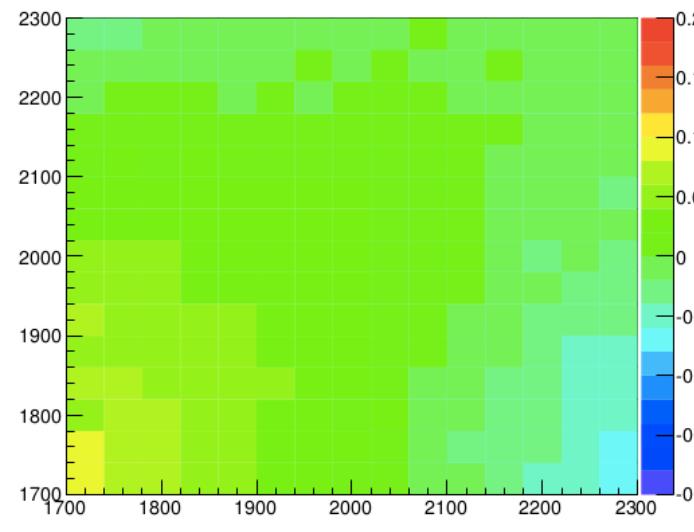
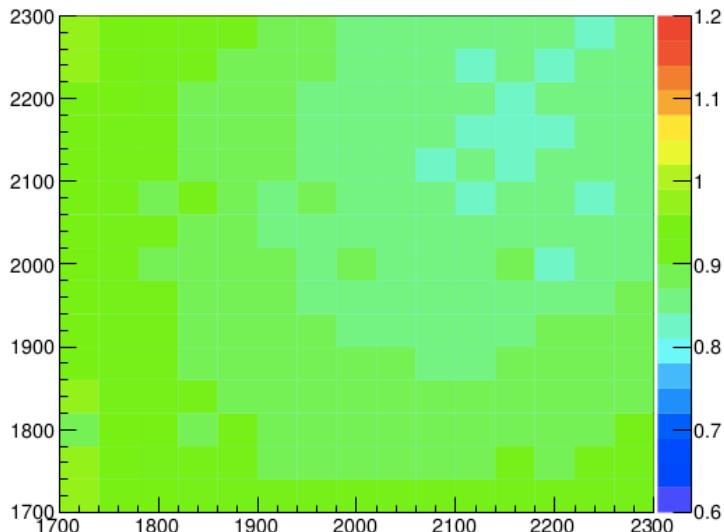
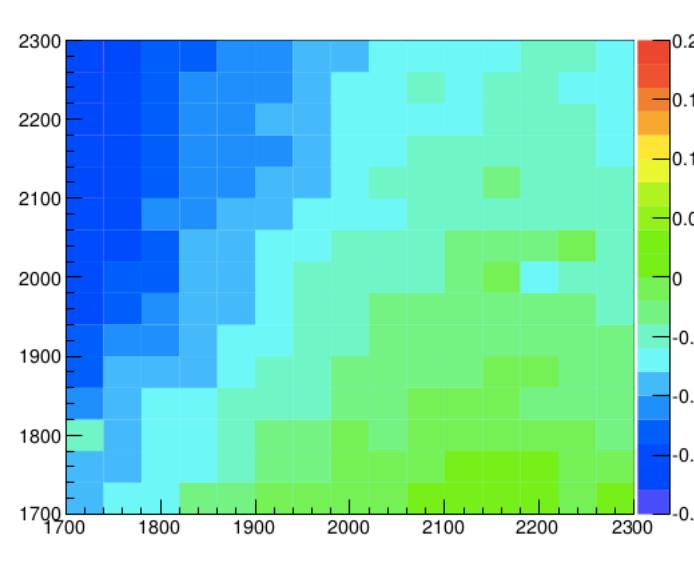
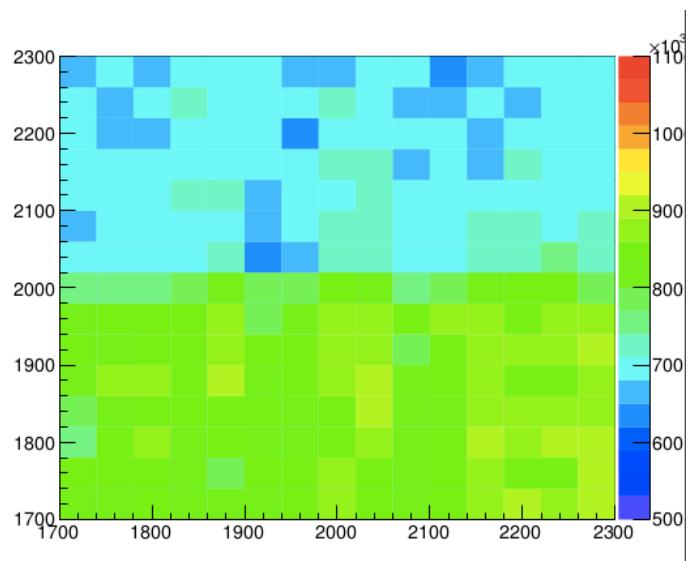
New BNL data

- Taken 2015/4/10 using CCD+LSST custom electronics
- 18 bit ADC (max 262,000) → different ADU/e conversion
- e2v sensor → can assemble the image

- Flux, sigma, distance in x, distance in y

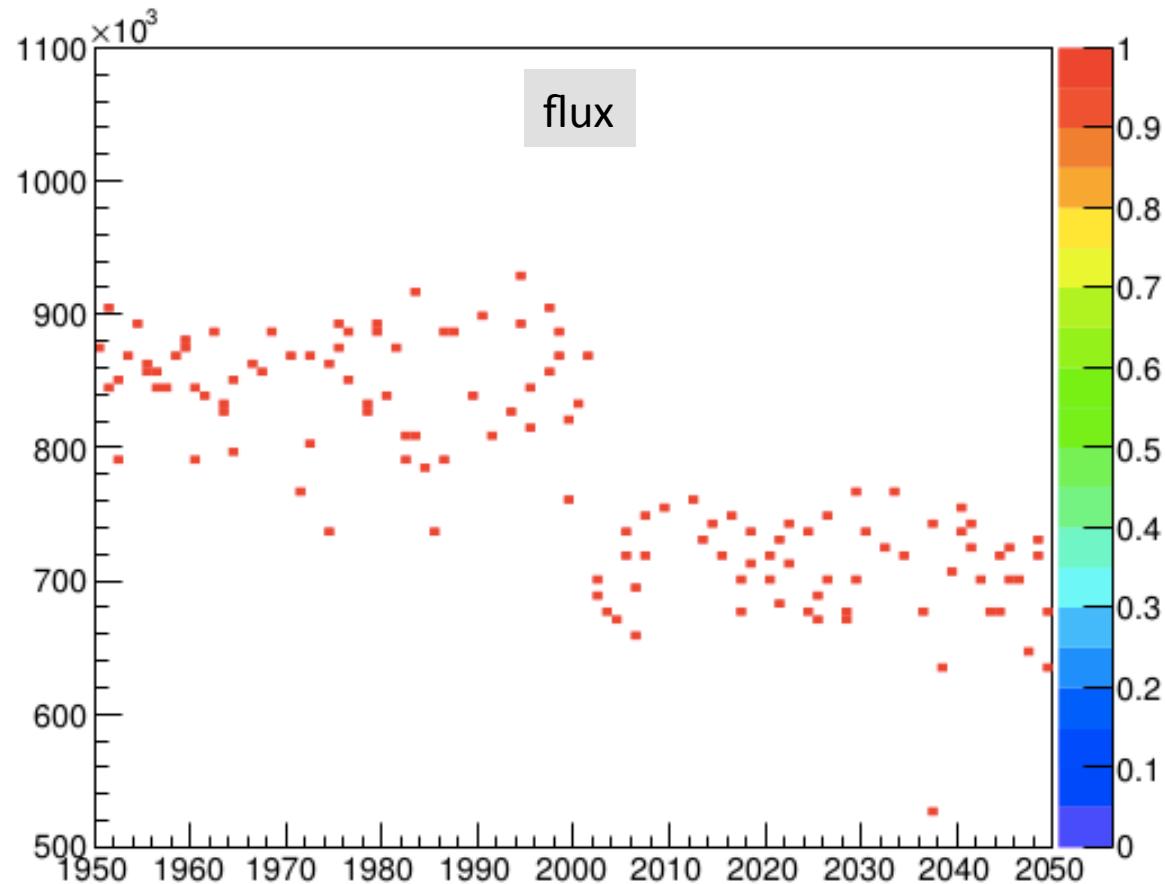


- Flux, Sigma, g1 and g2

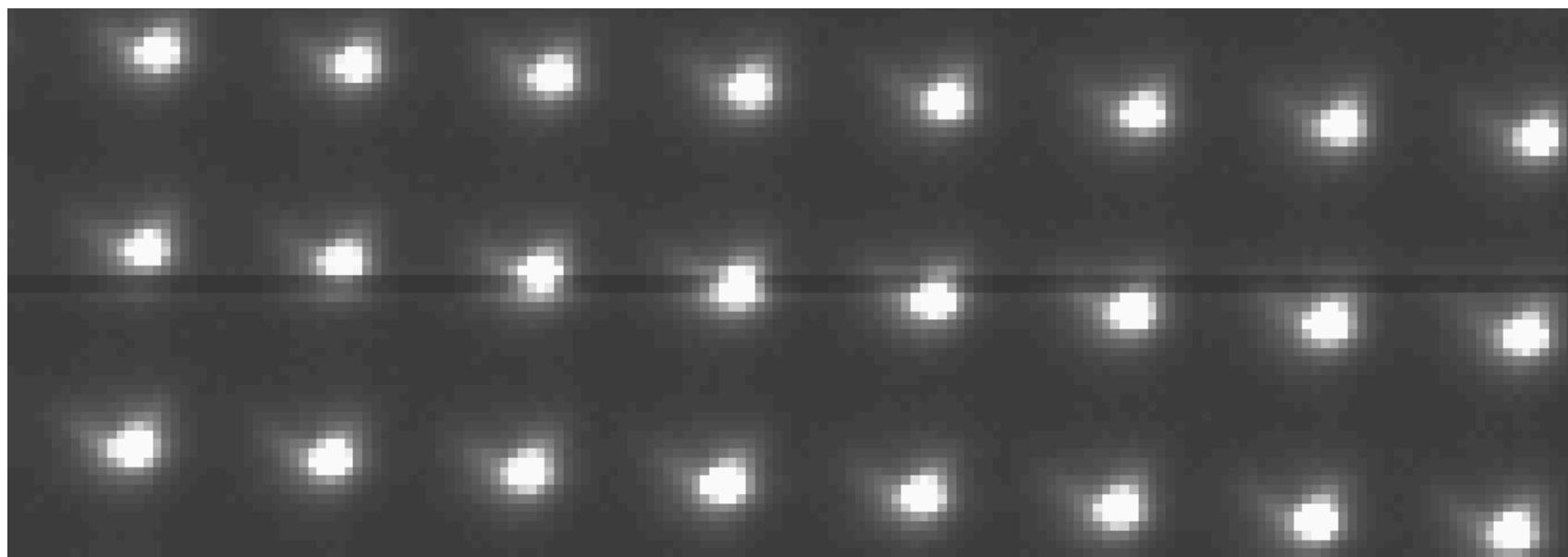
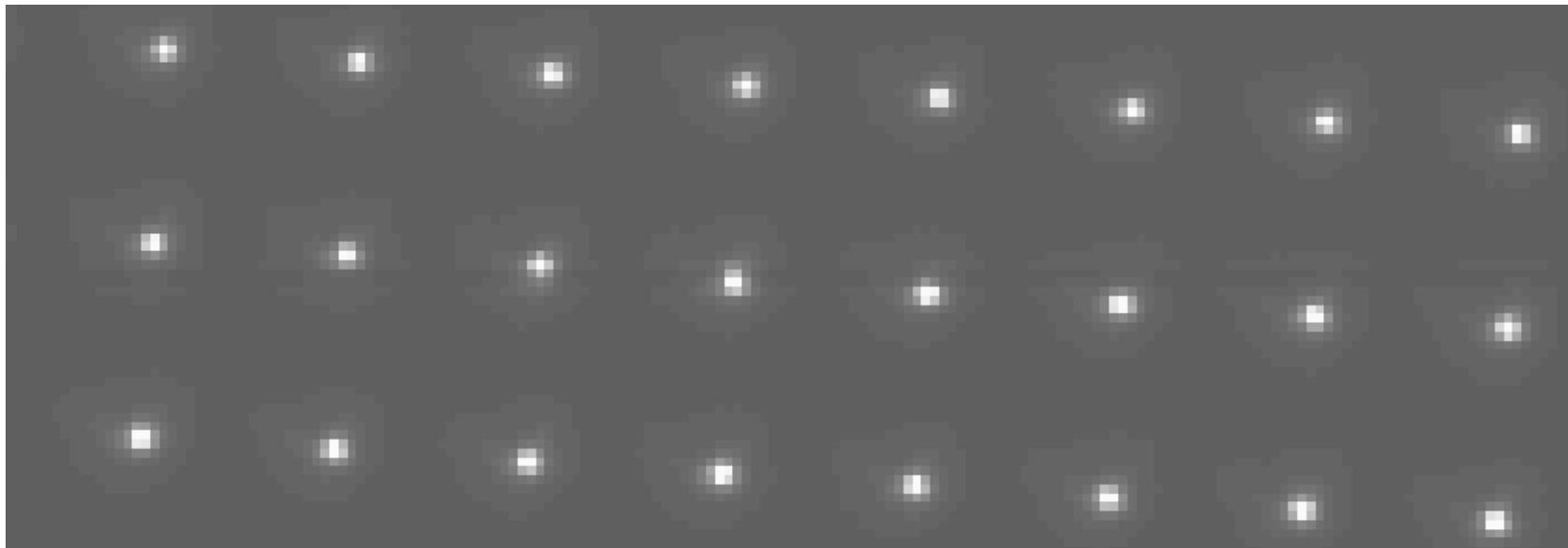


Midline in y

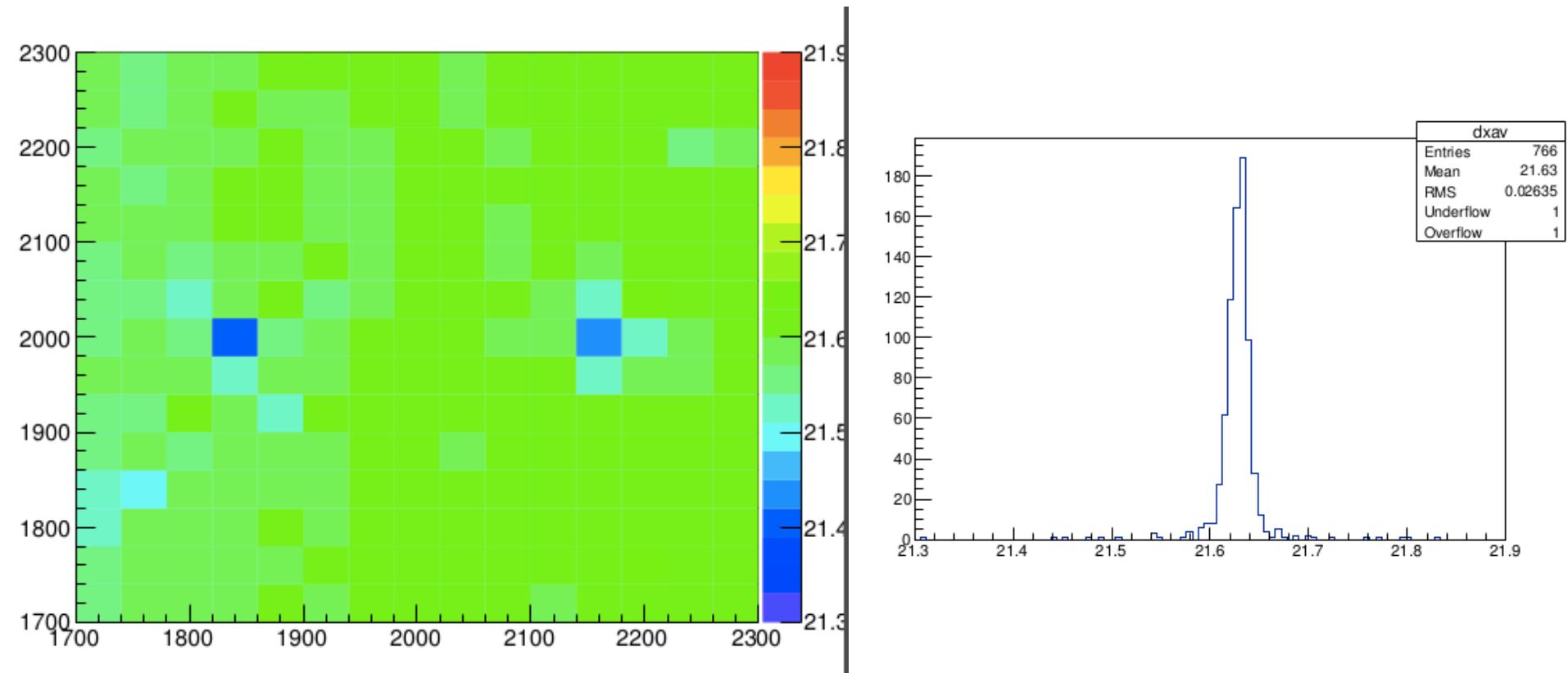
- Flux is not gain corrected yet



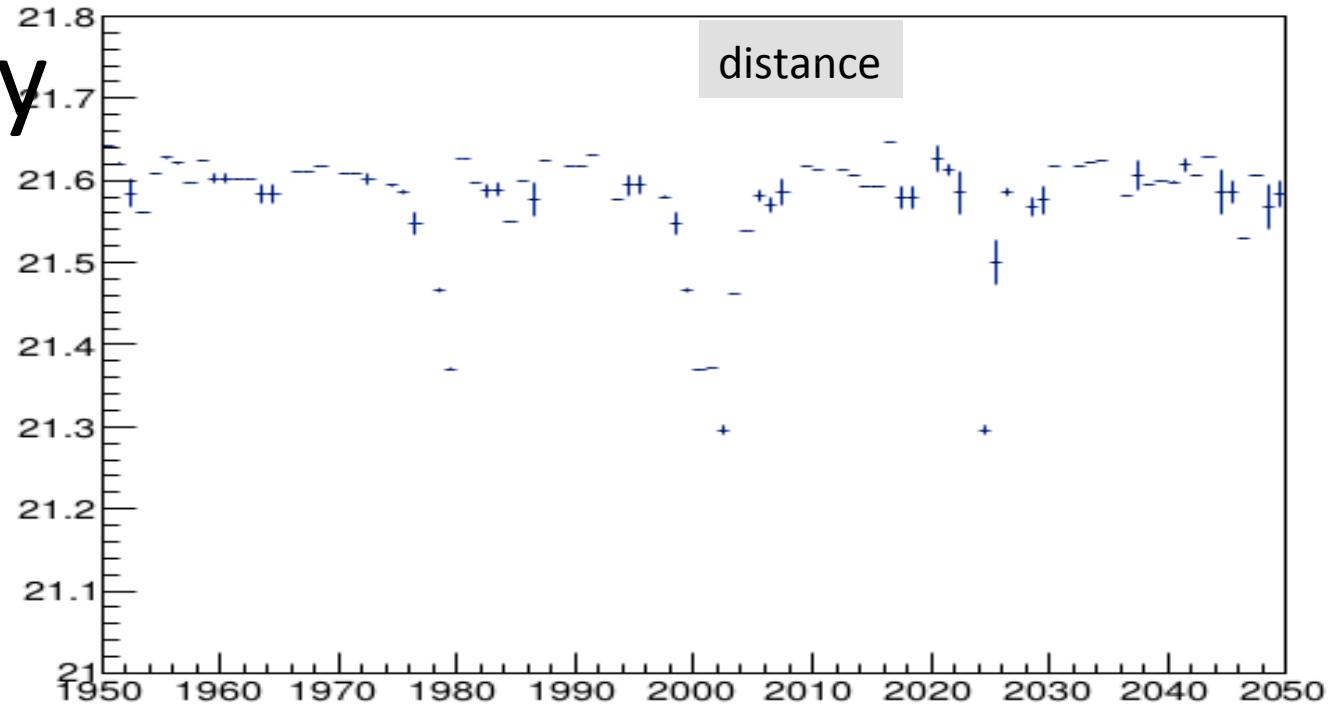
Midline in ds9



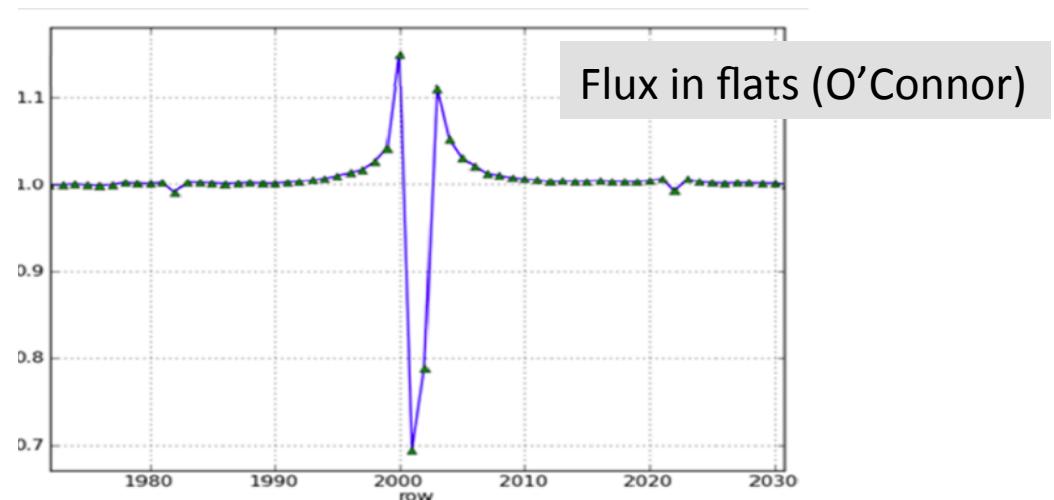
- **distance**



Midline in y

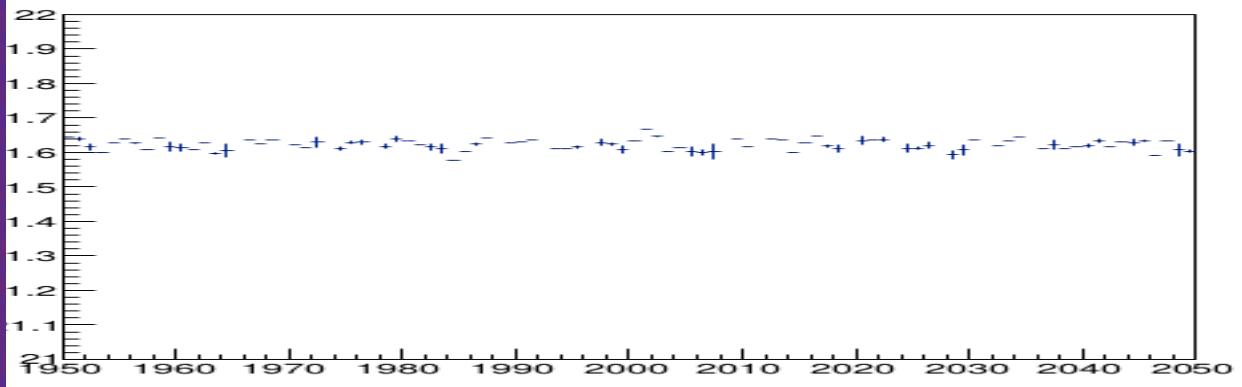
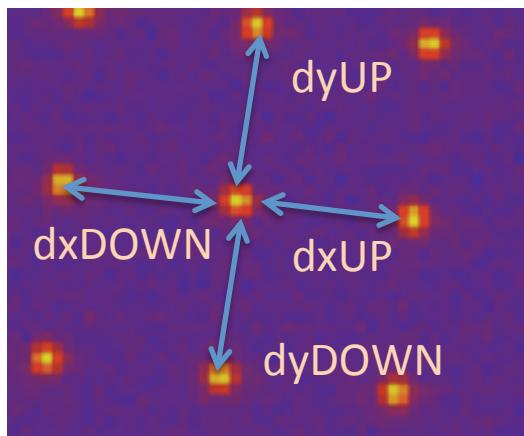
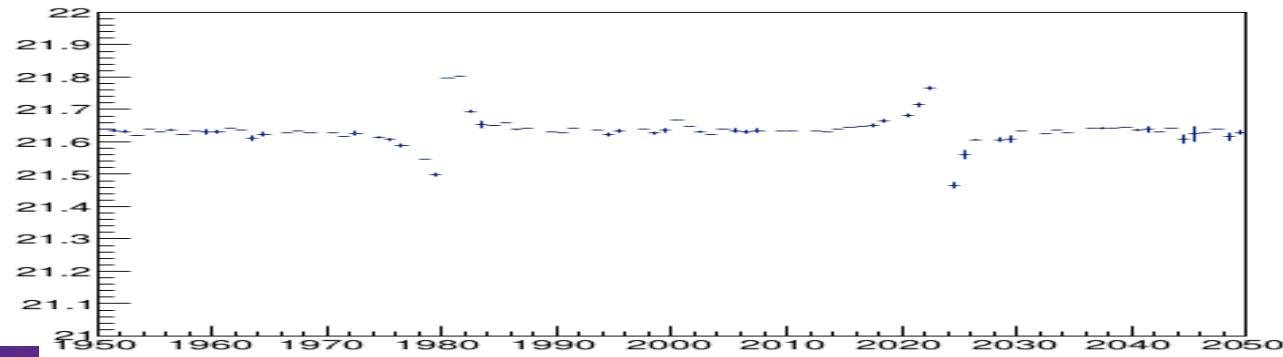
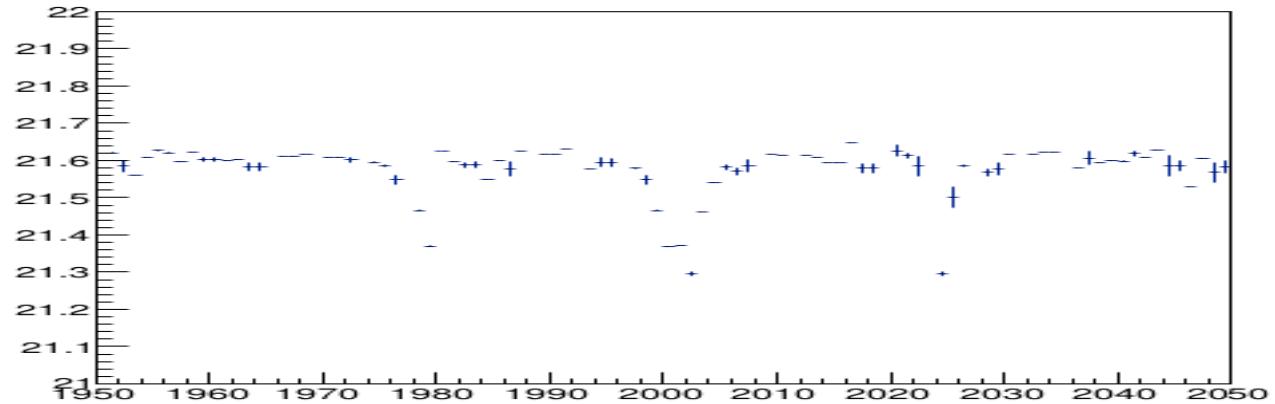


See midline and two
satellites?



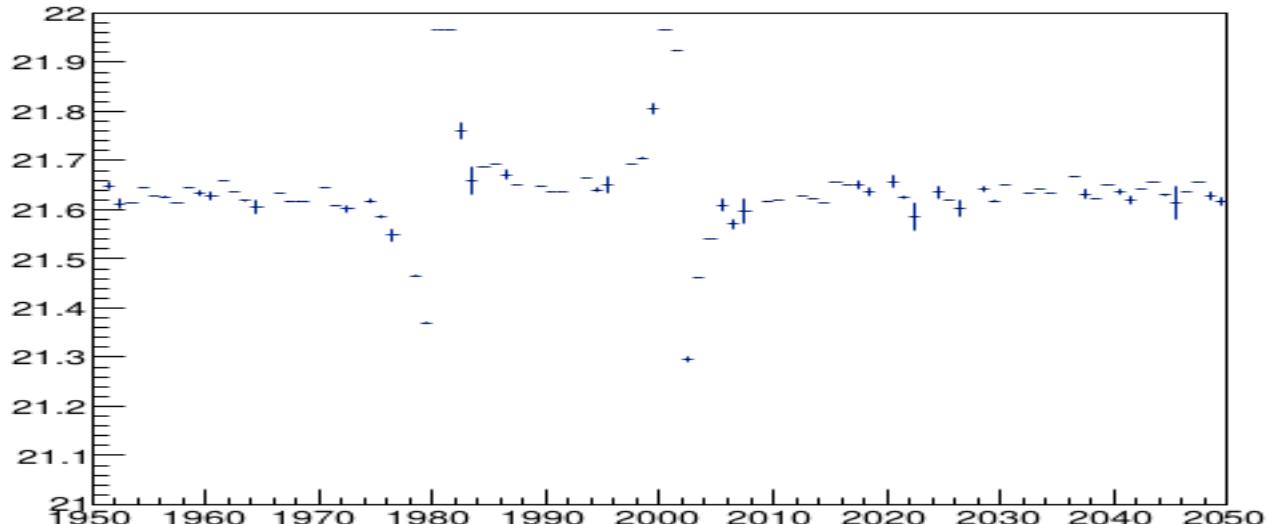
Distances around midline

- Closest neighbor
- Average in x direction
 - $(dx_{UP}+dx_{DOWN})/2$
- Average in y direction
 - $(dy_{UP}+dy_{DOWN})/2$

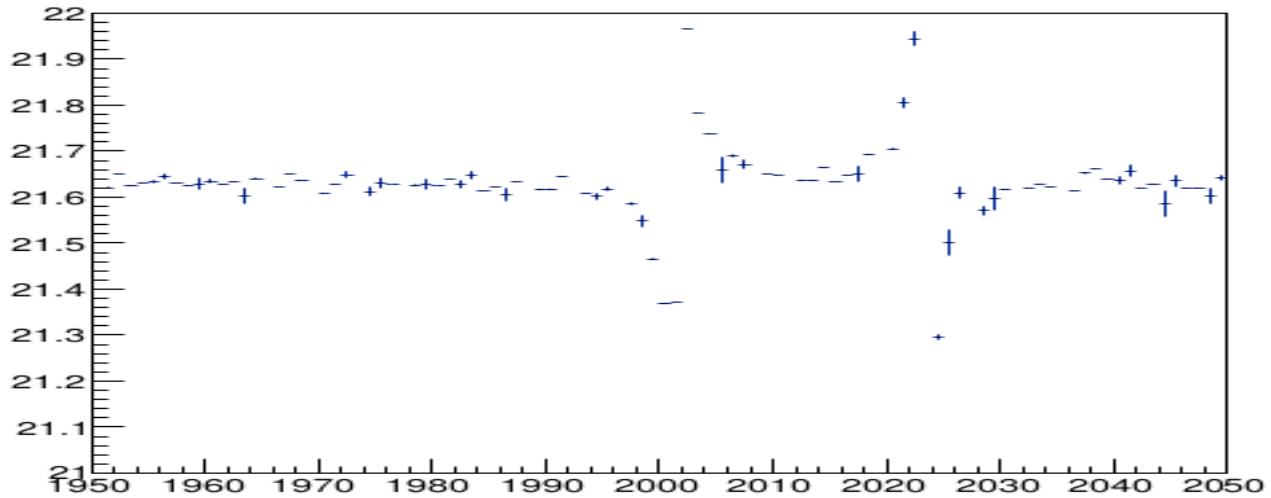
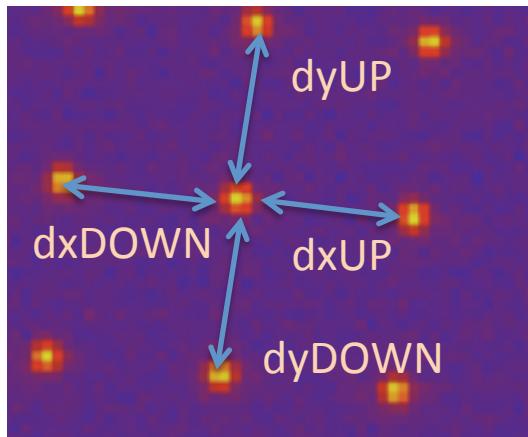


Distances in x

- dxUP

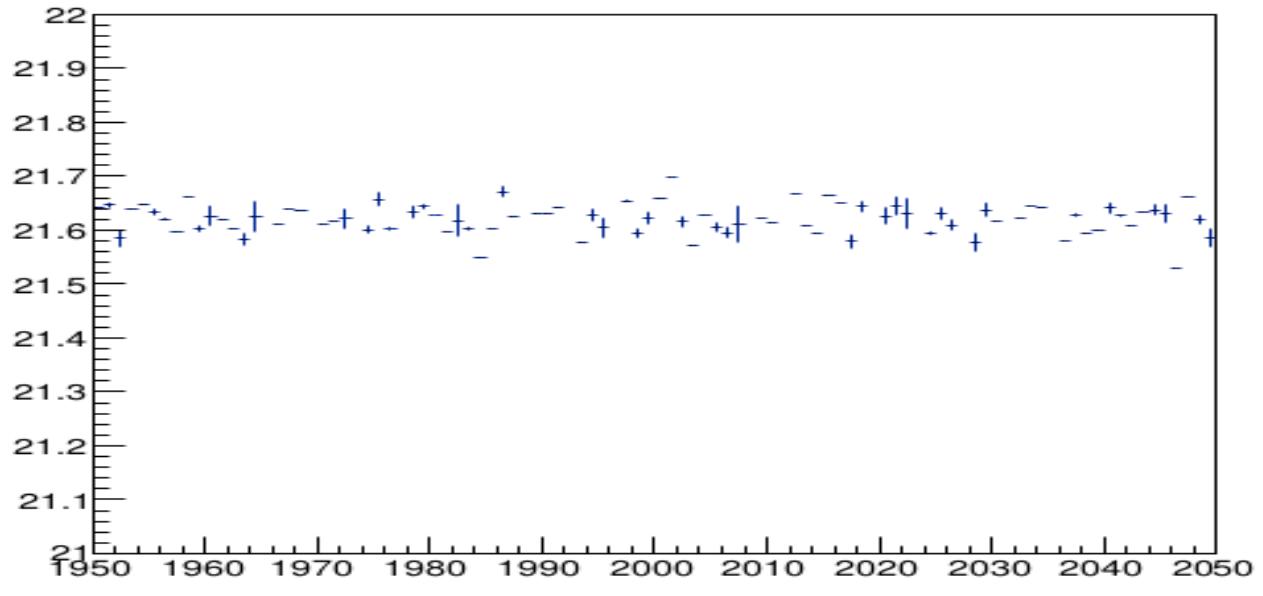


- dxDOWN

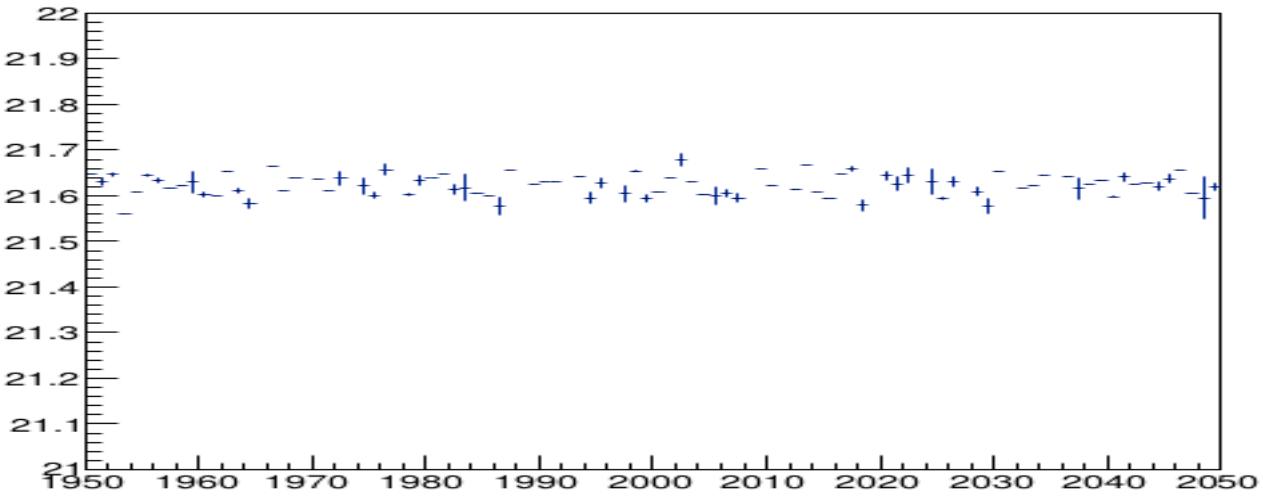
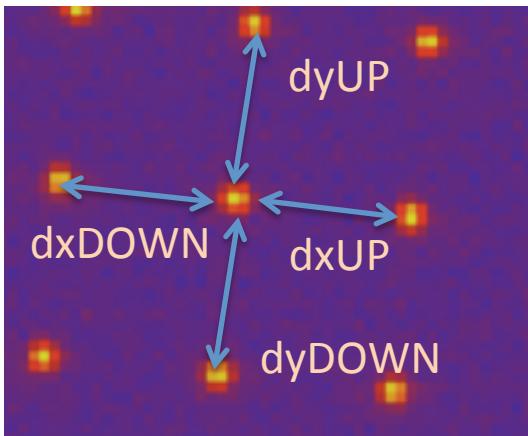


Distances in y

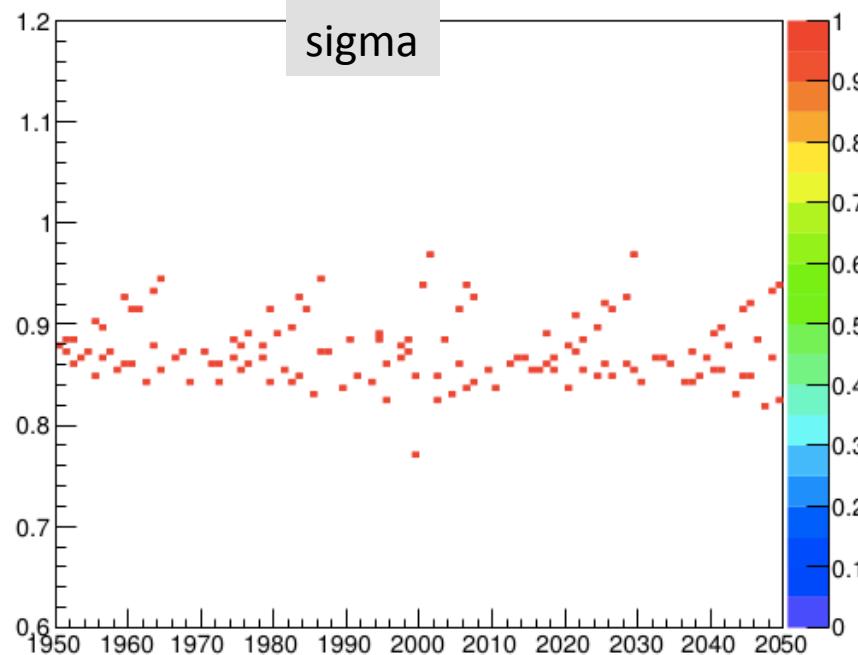
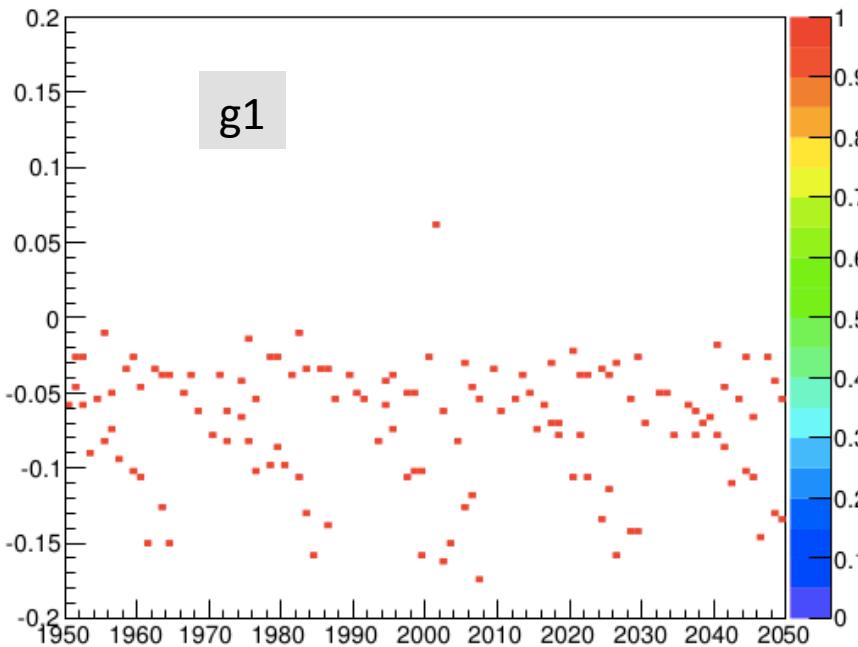
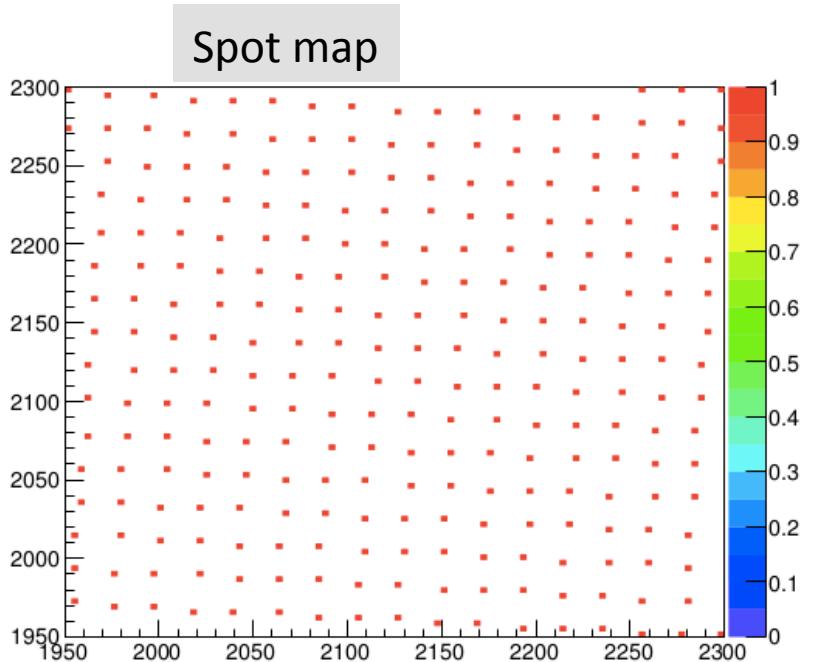
- dyUP



- dyDOWN



Midline in y



g1 and sigma has larger scatter than distance

- Same line in x – nothing interesting

